AP Chemistry
Syllabus

Course Description:

In keeping with the objectives of the College Board, students enrolled in AP Chemistry will cover content equivalent to what is presented in two semesters of college general chemistry. Upon successful completion of this course and achievement of a satisfactory score on the AP Chemistry Examination, students may have the opportunity to receive general chemistry credits or place out of general chemistry classes and move into more advanced science courses during their first years in college.

During the first semester, students will review concepts presented during their first course of high school chemistry beginning with problem solving skills, data collection, significant figures, stoichiometry, and the basics of the periodic table and general properties of matter. Moving from this review foundation, students will study chemical reactions, solutions, properties of gases and thermochemistry before focusing in on a more in depth examination of the periodic table and chemical bonding.

Students will explore the intricate differences between solids and liquids as they begin the second semester. Properties of solutions and reactions of acids and bases follow logically after. In addition students will also study chemical kinetics, equilibria, spontaneity, free energy, entropy, and electrochemistry during the second half of this course.

Throughout both semesters of AP Chemistry, an emphasis will be placed upon problem solving skills, descriptive chemistry, development and use of models to explain chemical principles, and the prediction of products in chemical reactions. The skills and content offered in this course along with those in the laboratory and review components have been chosen to adequately prepare students for the AP Chemistry Examination and future success in college science courses.

Text:

Zumdahl, S. S. *Chemistry*, 6th ed. Boston: Houghton Mifflin, 2003.

- Student edition with technology package: ISBN 0-618-34231-1
- Student Solutions Manual ISBN 0-618-22163-8
- Study Guide ISBN 0-618-22162-X (optional but suggested)

Calculator:

Any scientific calculator may be used.

Topic Outline – (for detailed schedule see the course outline)

- Liquids and Solids
- Properties of Solutions
- Chemical Kinetics
- Chemical Equilibrium
    - Midterm Examination

- Acids and Bases
- Applications of Aqueous Equilibria
- Spontaneity, Entropy, and Free Energy
- Electrochemistry
    - Final Examination

Learning Outcomes

(Taken from the Instructor's Resource Guide for the text.)

CHAPTER TEN: LIQUIDS AND SOLIDS

Chapter Learning Goals:

Section One:	To define dipole-dipole force, hydrogen bonding forces, and London dispersion forces. To describe the effects these forces have on the properties of liquids and solids.
Section Two:	To describe some properties of liquids: surface tension, capillary action, and viscosity.
Section Three:	To contrast crystalline and amorphous solids. To introduce X-ray diffraction as a means for structure determination.
Section Four:	To discuss the concept of closest packing of metal atoms. To describe two models for bonding in metals. To define and classify alloys.
Section Five:	To show how the bonding in elemental carbon and silicon accounts for the widely different properties of their compounds. To explain how a semiconductor works.
Section Six:	To describe the bonding in molecular solids.
Section Seven:	To model the structures of ionic solids using the packing of spheres.
Section Eight:	To define the vapor pressure of a liquid. To discuss the features of heating curves.
Section Nine:	To discuss the features of phase diagrams.

CHAPTER ELEVEN: PROPERTIES OF SOLUTIONS

Chapter Learning Goals:

Section One:	To define various ways of describing solution composition.
Section Two:	To define the heat of solution and discuss its various energy components.
Section Three:	To show how molecular structure, pressure, and temperature affect solubility.

Section Four:	To show how a solution's vapor pressure is affected by the concentration of solute and the interactions of solute and solvent.
Section Five:	To explain the effect of a solute on the boiling and freezing points of a solvent.
Section Six:	To explain osmosis and describe its application.
Section Seven:	To show how the colligative properties of electrolyte solutions can be used to characterize the solute.
Section Eight:	To define a colloid and explain how it is stabilized.

CHAPTER TWELVE: CHEMICAL KINETICS

Chapter Learning Goals:

Section One:	To define the reaction rate and to show how rates can be measured from experimental data.
Section Two:	To describe the two types of rate laws.
Section Three:	To learn methods for determining the rate law for a reaction.
Section Four:	To develop rate laws relating concentration to reaction time and to show how they can be used to determine reaction order.
Section Five:	To summarize the two types of rate laws and the methods by which they can be determined.
Section Six:	To explore the relationship between the reaction pathway and the rate law.
Section Seven:	To discuss the temperature dependence of reaction rates. To describe the collision model. To define and show how to calculate activation energy.
Section Eight:	To explain how a catalyst speeds up a reaction. To discuss heterogeneous and homogeneous catalysis.

CHAPTER THIRTEEN: CHEMICAL EQUILIBRIUM

Chapter Learning Goals:

Section One:	To discuss how equilibrium is established.
Section Two:	To introduce the law of mass action and to show how to calculate values for the equilibrium constant.
Section Three:	To show how K and K_p are related.
Section Four:	To show how condensed phases are treated in constructing the equilibrium expression.
Section Five:	To show how the equilibrium constant is used to predict the direction in which a system will move to reach equilibrium. To demonstrate the calculation of equilibrium concentrations given initial concentrations.
Section Six:	To generalize the procedure for doing equilibrium calculations.
Section Seven:	To show how to predict the changes that occur when a system at equilibrium is disturbed.

CHAPTER FOURTEEN: ACIDS AND BASES

Chapter Learning Goals:

Section One:	To discuss two models of acids and bases and to relate equilibrium concepts to acid dissociation.
Section Two:	To relate acid strength to the position of the dissociation equilibrium. To discuss the autoionization of water.
Section Three:	To define pH, pOH, and pK and to introduce general methods for solving acid-base problems.
Section Four:	To demonstrate the systematic treatment of solutions of strong acids.
Section Five:	To demonstrate the systematic treatment of solutions of weak acids. To show how to calculate percent dissociation.
Section Six:	To introduce equilibria involving strong and weak bases. To show how to calculate pH for basic solutions.
Section Seven:	To describe the dissociation equilibria of acids with more than one acidic proton.
Section Eight:	To explain why certain salts give acidic or basic solutions and to show how to calculate the pH of these solutions.
Section Nine:	To show how bond strength and polarity affect acid-base properties.
Section Ten:	To show how to predict whether an oxide will produce an acidic or basic solution.
Section Eleven:	To define acids and bases in terms of electron pairs.
Section Twelve:	To summarize the major species approach to solving acid-base problems.

CHAPTER FIFTEEN: APPLICATIONS OF AQUEOUS EQUILIBRIA

Chapter Learning Goals:

Section One:	To study the effect of a common ion on acid dissociation equilibria.
Section Two:	To explain the characteristics of buffered solutions. To show how to calculate a buffer pH given the concentrations of the buffering materials.
Section Three:	To describe the meaning of buffer capacity.
Section Four:	To demonstrate how to calculate the pH at any point in an acid-base titration.
Section Five:	To explain how acid-base indicators work.
Section Six:	To show how to calculate the solubility product of a salt given its solubility, and vice versa.

	To demonstrate the prediction of relative solubilities from K_{sp} values.
	To explain the effect of pH and a common ion on the solubility of a salt.
Section Seven:	To show how to predict whether precipitation will occur when solutions are mixed.
	To describe the use of selective precipitation to separate a mixture of ions in solution.
Section Eight:	To apply the principles of equilibrium to the formation of complex ions.
	To show how complex ion formation can increase the solubility of a salt.

CHAPTER SIXTEEN: SPONTANEITY, ENTROPY, AND FREE ENERGY

Chapter Learning Goals:

Section One:	To define a spontaneous process.
	To define entropy in terms of positional probability.
Section Two:	To state the second law of thermodynamics in terms of entropy.
Section Three:	To discuss the important characteristics of entropy changes in the surroundings.
	To apply the relationship between ΔS_{surr}, ΔH, and T (K).
Section Four:	To define free energy and relate it to spontaneity.
Section Five:	To apply positional probability to chemical reactions.
	To relate molecular complexity to entropy.
Section Six:	To show how to calculate the standard free energy change in a chemical reaction.
	To define standard free energy of formation and show how to use it to predict spontaneity.
Section Seven:	To relate free energy to pressure.
Section Eight:	To define equilibrium in terms of minimum free energy.
	To show how the value of K is related to $\Delta G°$.
Section Nine:	To relate work done to the change in free energy.

CHAPTER SEVENTEEN: ELECTROCHEMISTRY

Chapter Learning Goals:

Section One:	To review oxidation and reduction.
	To define the components of an electrochemical cell.
	To distinguish between a galvanic cell and an electrolytic cell.
	To define cell potentials.

Section Two:	To describe how standard reduction potentials are assigned in terms of the standard hydrogen electrode. To demonstrate the combination of half-reactions to form the cell reaction. To characterize a galvanic cell.
Section Three:	To relate the maximum cell potential to the free energy difference between cell reactants and products.
Section Four:	To discuss the driving force in concentration cells. To quantify how to calculate the relationship between cell potential and cell concentration. To show how to calculate equilibrium constants from cell potentials.
Section Five:	To discuss the composition and operation of commonly used batteries.
Section Six:	To explain the electrochemical nature of corrosion and describe some means for preventing it.
Section Seven:	To describe the stoichiometry of electrolysis reactions. To show how to predict the order of electrolysis of the components of a mixture.
Section Eight:	To discuss the manufacture of aluminum, the chlor-alkali process, and other industrial applications of electrolysis.

Assignments and Grading

There are four major types of assignments for this course: homework, discussion tasks, weekly quizzes and examinations. A brief description of each and the associated policies follows.

- ***Homework*** – Students will have a homework task that should be completed each day. The homework corresponds to the topics presented in the reading and lecture for a particular day and often requires the student to synthesize information and concepts from prior lessons. The majority of homework problems have been taken from the text, however there are also simulated lab exercises, questions about the AP examination, and other forms of homework.

  Homework solutions being submitted for grading should not only show the answer to a given problem, but should also clearly show all work involved in order to determine a final solution or an explanation of the problem-solving process used to determine the final answer. Homework will be uploaded for instructor review by the end of the day on which it is assigned and before students move to the next day's tasks. The instructor will review all homework submissions, add comments, and return the annotated work to the individual student.

  Homework will be graded for both completeness and accuracy. Students will receive 7 points for each assignment that is complete and submitted on time. In addition, the instructor will randomly select and grade the same 6 questions/problems on each student's homework for accuracy. The student will

receive 0.5 points for each of these responses that is correct. The maximum score for each homework assignment is 10 points.

The homework grades for each particular student will be averaged and will constitute 20% of the student's final grade for the course.

- ***Discussion Tasks*** – There are two types of discussion tasks that will be used in this course, synchronous and asynchronous.

  During synchronous discussions students will "meet" with the instructor at least once per week in a one-hour chat. This forum provides an excellent opportunity for students to ask relevant questions, get help with problematic material, and make helpful suggestions to other students. There will be two synchronous discussions per week; students are required to attend at least one. Students are welcome to attend both discussions. There will be topics suggested in the Course Outline that will serve to guide the discussions, however any pertinent topic is allowed.

  Asynchronous discussions are threaded discussions during which students post responses to discussion questions that would be similar to those discussed in a face-to-face classroom setting. Students are required to post two answers each week to two separate questions (see Course Outline for questions and dates). By the last day of each week, students are required to read and respond to at least two of their classmates' postings.

  Discussions will comprise 20% of the student grade for this course. Each student response should be about 1-2 paragraphs in length. All responses should show that the student is not only reflecting on the question within the context of current material, but that he/she is also synthesizing ideas across topics addressed in the course. Students should provide support for their answers, citing examples from the text, the real world, and/or their own experiences. Postings will be graded on completeness, pertinence and accuracy of answer, timeliness of submission, and grammar and sentence structure.

- ***Weekly Quizzes*** – Each week students will complete a quiz on the current week's material. Quizzes are between 20 and 60 questions in length. Students will be required to complete each quiz within 2 hours of the time of download (force complete and 2 hour time limit). While completing the quizzes, students may use reference charts and a calculator as discussed in the class lecture notes. The questions on weekly quizzes are predominantly multiple-choice although the student may find a few true/false, problem solving, or fill in the blank. Each question on the quiz will be worth 1 point. Quiz grades will be averaged and will comprise 20% of the students' final grades for the course.

- ***Examinations*** – There are two examinations for this course. The midterm examination will be taken at the end of week four, before students begin week

five. The final examination will be taken at the end of week eight and will be cumulative. Each examination will comprise 20% of the students' final grades for the class.

The midterm examination does not have a free-response component. The exam consists of 80 questions. The questions are primarily multiple choice and true/false in nature. There are a few short answer/problem solving questions included. Each question will be equally weighted. Students may use calculators and the Periodic Table of the Elements while completing this examination. Students will have a maximum of four hours to complete this exam once they have downloaded it (force complete and time limit).

The final examination has two parts. The first part of the exam consists of 80 multiple-choice questions (each question is worth 1 point and this section of the test is worth 50% of the students' final exam grades). Students may use a calculator and a Periodic Table of the Elements to complete this section. Students will have three hours to complete this section of the exam once they have downloaded it (force complete and time limit). The second section of the final examination contains of the free-response questions from a past AP Chemistry Examination written by the College Board. Students will download this section of the test in PDF format or will find it using a link located in the instructions section for the final exam. Students will type all of their answers (showing all work and explanations) as a Word Document and submit it to the instructor within the time limit set for the exam. The point value associated with each question is written next to each item. This section of the exam is worth 50% of the students' final exam grades. Students may only use calculators for this portion of the exam. Reference tables are provided in the exam document. Students will have a maximum of two hours to complete this portion of the exam once they have downloaded it (force complete and time limit).

Grading Scale

As a reminder from above, the students' grades for this class will be calculated on their average scores for each of the course assignments (homework, discussion tasks, quizzes, midterm examination and final examination).

The following weighting system will be used for the course:

Homework 20%
Discussion Tasks 20%
Weekly Quizzes 20%
Midterm Examination 20%
Final Examination 20%

The grading scale that will be used for the course is as follows:

A 90 –100%
B 80 – 89%
C 70 – 79%

D 60 – 69%
F 0 – 59%

Workload – Students should expect to spend a ***minimum*** of 15-20 hours a week studying and completing the course readings, lecture notes, homework sets, discussion tasks, weekly quizzes and examinations. Students must be self-motivated and inclined to keep a regular schedule in order to not only keep up with, but to achieve success in this rigorous course.